

Message Text

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UNCLAS SECTION 1 OF 3 MANILA 13847

USADB

FOR NAC AGENCIES

E.O. 11652: NA

TAGS: EAID, EFIN, PK

SUBJECT: TARBELA HYDROPOWER PROJECT, PAKISTAN

REF: TREASURY 74-12, MANILA 13600; ISLAMABAD 1104

(EXCLUDING ANNEXES)

FOLLOWING IS TEXT/OF ADB DOC. IN.97-74 WHICH

UPDATES DEVELOPMENTS REGARDING TARBELA HYDROPOWER PROJECT, PAKISTAN:

QUOTE: 1. REFERENCE IS MADE TO DOC. R75-74

DATED 6 AUGUST 1974 ON THE PROPOSED LOAN TO PAKISTAN

FOR THE TARBELA HYDROPOWER PROJECT AND THE MEMORANDUM

OF 29 AUGUST ADVISING THE BOARD THAT SOME DAMAGE

HAD OCCURRED AT THE TARBELA DAM SITE AND DEFERRING

BOARD DISCUSSION ON THE PROJECT, AND TO DOC.

SEC.M93-74 OF 9 OCTOBER 1974 IN WHICH THE PRESIDENT

RECOMMENDED THE ISSUANCE OF INVITATIONS FOR THE

CONSULTANT SERVICES UNDER THE PROJECT PRIOR TO

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BOARD DISCUSSIONS. (FOOTNOTE 1)

(FOOTNOTE 1-THE BOARD RECORDED ITS APPROVAL OF THE RECOMMENDATION (DOC. M46-74 DATED 22 OCTOBER 1974).)

2. THE BANK CAME TO LEARN IN MID-AGUST 1974 THAT SOME PROBLEMS WITH THE TUNNEL HAD DEVELOPED DURING THE FILLING OF THE TARBELA RESERVOIR. SINCE THEN THE BANK HAS TRIED TO ASCERTAIN AND ESTABLISH AS CLEARLY AS POSSIBLE WHAT HAD HAPPENED, AND THE IMPACT THEREOF BOTH ON THE TARBELA MULTIPURPOSE DAM AND ON THE BANK'S PROPOSED PROJECT (FOOTNOTE 2) - THE FIRST EXTENSION OF THE TARBELA HYDROPOWER STATION. IT HAS BEEN ESTABLISHED THAT THE DAMAGE, WHILE SEVERE AND COSTLY TO REPAIR, IS RESTRICTED TO THE TUNNEL AREA, AND ONCE REPAIRED WILL NOT AFFECT THE PROPER FUNCTIONING OF THE TARBELA DAM OR POWER STATION.

(FOOTNOTE 2-FOR DETAILED DESCRIPTION OF THE PROJECT AND THE TARBELA DAM, PLEASE REFER TO THE APPRAISAL REPORT CIRCULATED UNDER DOC. R75-74 DATED 6 AUGUST 1974.)

3. THE DAMAGE WAS CAUSED BY A CHAIN OF EVENTS WHICH COULD NOT OCCUR DURING THE SECOND FILLING OF THE RESERVOIR SCHEDULED FOR MID-1975. IT IS, THEREFORE, RECOMMENDED THAT THE PROJECT SHOULD BE CONSIDERED BY THE BOARD IN THE LATTER PART OF NOVEMBER OR EARLY DECEMBER 1974 IN ORDER TO KEEP THE EXECUTION OF THE WORK ON THE ORIGINAL TIME SCHEDULE. REPAIRS ARE NOW PROCEEDING AND A FURTHER VISIT TO THE TARBELA DAM SITE BY STAFF WILL TAKE PLACE TO PROVIDE THE BOARD WITH THE LASTEST INFORMATION AT THE TIME IT DISCUSSES THE PROJECT.

4. THIS MEMORANDUM DESCRIBES WHAT HAPPENED ON THE BASIS OF INFORMATION PROVIDED TO GHE BANK BY THE WATER AND POWER DEVELOPMENT AUTHORITY (WAPDA) -- THE EXECUTING AGENCY, IBRD AND THEIR RESPECTIVE CONSULTANTS. IT ALSO PRESENTS AN ASSESSMENT OF THE OVERALL EVENTS AS CONCLUDED DURING A MEETING OF HIGH-LEVEL CONSULTANTS INCLUDING DAM DESIGN ENGINEERS, HYDRAULIC AND SOIL MECHANICS ENGINEERS AND SUBSEQUENT INFORMATION RECEIVED FROM WAPDA AND IBRD.

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5. THE MEETING OF THE "SPECIAL CONSULTANTS" WAS HELD AT TARBELA FROM 27 SEPTEMBER TO 4 OCTOBER 1974. (SUCH MEETINGS HAVE BEEN AN ANNUAL EVENT SINCE CONSTRUCTION OF TARBELA STARTED, AND THE HIGH-LEVEL EXPERTS WERE FULLY FAMILIAR WITH THE DESIGN CONCEPT, THE ENGINEERING PROBLEMS AND DIFFICULTIES INVOLVED IN THE CONSTRUCTION OF THIS LARGE DAM WHEN MAKING THEIR ASSESSMENT.) THIS MEETING WAS ATTENDED BY BANK STAFF. IT WAS CONDUCTED

UNDER THE CHAIRMANSHIP OF WAPDA AND WAS ALSO ATTENDED BY A HIGH-LEVEL IBRD MISSION AND OFFICIALS OF THE GOVERNMENT OF PAKISTAN. TIPPETTS, ABBETT, MCCARTHY AND STRATTON (TAMS), A U.S. CONSULTANT FOR THE DETAILED DESIGN AND CONSTRUCTION SUPERVISION, REPORTED IN DETAIL ON ALL ASPECTS OF THE RESERVOIR FILLING AND SUBSEQUENT EVENTS. DETAILED CLARIFICATION WAS SOUGHT NOT ONLY BY THE PANEL OF "SPECIAL CONSULTANTS" BUT ALSO BY SPECIALIZED ENGINEERS FROM SIR ALEXANDER GIBB AND PARTNERS (CONSULTANT TO THE IBRD) AND HARZA INTERNATIONAL, A U.S. CONSULTANT SUPERVISING THE PROJECT ON BEHALF OF WAPDA. A PANEL OF PAKISTANI ENGINEERS WAS ALSO REPRESENTED. THE "SPECIAL CONSULTANTS" PREPARED A REPORT WHICH WAS PRESENTED ON THE FINAL DAY OF THE MEETING INDICATING THEIR CONCLUSIONS AND GIVING THEIR RECOMMENDATIONS ON THE REPAIR WORK AND THE SECOND FILLING OF THE RESERVOIR IN 1975.

THE MAIN DAM

6. THE MAIN DAM IS AN EARTHFILL DAM WITH IMPERMEABLE CORE ON A GRAVEL FOUNDATION (THE ALLUVIAL GRAVEL BED ON THE DAM SITE IS ABOUT 700 FEET DEEP). WHILE EARTHFILL DAMS ARE QUITE COMMON AND INHERENTLY SAFE, GRAVEL FOUNDATIONS HAVE TO BE CAREFULLY OBSERVED IN REGARD TO SEEPAGE CONTROL. THE REPORT OF THE "SPECIAL CONSULTANTS" DATED 4 OCTOBER 1974 CONCLUDED THAT ALTHOUGH SEEPAGE WAS IN EXCESS OF WHAT WAS EXPECTED, AND CERTAIN CORRECTIVE MEASURES MUST BE IMPLEMENTED, THE SEEPAGE CONTROL MEASURES ADOPTED FOR THE DAM DESIGN WORKED SATISFACTORILY. BECAUSE THE RESERVOIR WAS NOT COMPLETELY FILLED IN 1974 AND THE TIME OF TESTING WAS LIMITED, THE "SPECIAL CONSULTANTS" HAVE RECOMMENDED THAT THE SEEPAGE TEST BE CONTINUED TO COMPLETION IN 1975. THIS DECISION REQUIRES THAT IN THE UNLIKELY EVENT THAT THIS TEST WILL NOT DEMONSTRATE SATISFACTORY PERFORMANCE, THE RESERVOIR MAY HAVE TO BE DRAWN DOWN AGAIN IN ORDER TO EFFECT ADDITIONAL SEEPAGE CONTROL

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WORK AND CERTAIN IMPORTANT PROVISIONS MUST BE INCLUDED DURING THE REPAIR WORKS TO ALLOW FOR THIS CONTINGENCY, NOTABLY THE REHABILITATION OF THE TEMPORARY DIVERSION GATES ON TUNNELS 1 AND 2.

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ACTION TRSE-00

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UNCLAS SECTION 2 OF 3 MANILA 13847

USADB

FOR NAC AGENCIES

E.O. 11652: NA

TAGS: EAID, EFIN, PK

SUBJECT: TARBELA HYDROPOWER PROJECT, PAKISTAN

REF: TREASURY 74-12, MANILA 13600; ISLAMABAD 1104

(EXCLUDING ANNEXES)

7. AN EARTH DAM IS ESPECIALLY STABLE AGAINST EARTHQUAKES AND THE DESIGN FOR THE TARBELA DAM WAS PREPARED IN ACCORDANCE WITH LOCAL SEISMIC CONDITIONS. THE SMALL MAGNITUDE OF SETTLEMENT OF THE DAM BY COMPRESSION UNDER THE WEIGHT OF THE DAM HAS SATISFACTORILY DEMONSTRATED THE SAFETY OF THE STRUCTURE AND ITS FOUNDATIONS. THE UPSTREAM SLOPE OF THE DAM SHOWED NO SIGNS OF INSTABILITY UNDER THE VERY SEVERE RESERVOIR DRAWDOWN CONDITIONS WHICH WERE NECESSITATED WHEN GATES OF TUNNELS 1 AND 2 COULD NOT BE CLOSED AND THE DAM STRUCTURE WAS NOT AFFECTED BY THE DAMAGE TO THE TUNNEL OUTLET WORKS. WHILE SEEPAGE HAS BEEN IN EXCESS OF THE EXPECTED AMOUNTS, THIS IS NOT CONSIDERED SERIOUS, AND WILL BE CORRECTED

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USING PROVEN TECHNIQUES. IT IS CLEAR THAT THE DESIGN AND CONSTRUCTION OF THE DAM IS COMPLETELY SATISFACTORY.

DAM ABUTMENTS

8. THE GEOLOGICAL FORMATIONS OF THE LEFT AND RIGHT ABUTMENTS OF THE DAM HAVE PRESENTED DIFFICULTIES, AND OBSERVATIONS MADE DURING FILLING OF THE RESERVOIR INDICATE THAT IN SPITE OF GROUTING, SEEPAGE IN EXCESS OF DESIGN CRITERIA WAS DETECTED PASSING THROUGH THE ABUTMENTS, MAINLY VIA A PERVIOUS LIMESTONE FORMATION. THE REPORT OF THE "SPECIAL CONSULTANTS" RECOMMENDS IMPLEMENTATION OF ADDITIONAL GROUTING AND ADDITIONAL DRAINAGE WORKS TO REDUCE THE PASSAGE OF WATER TO AN ACCEPTABLE LEVEL. GROUTING CAN BE INITIATED IMMEDIATELY AND IS NOT EXPECTED TO PRESENT FURTHER TECHNICAL PROBLEMS AS THE DIFFICULT GEOLOGICAL CONDITIONS ON THE DAM SITE WERE KNOWN WHEN THE TARBELA DAM SITE WAS SELECTED. IT IS CONSIDERED THAT THE SEEPAGE CONDITIONS CAN BE FULLY CONTROLLED.

DAMAGE TO TUNNELS 1, 2, 3 AND 4

9. FOUR TUNNELS WERE CONSTRUCTED PASSING THROUGH THE RIGHT ABUTMENT OF THE TARBELA DAM, TWO OF THEM, TUNNELS 3 AND 4, WILL BE USED INITIALLY AS IRRIGATION OUTLETS, WHILE TUNNELS 1 AND 2 WHICH SERVED AS DIVERSION TUNNELS DURING THE CONSTRUCTION OF THE DAM WILL BE CONVERTED TO SERVE AS POWER TUNNELS AND CAN BE DIVERTED TO THE POWERHOUSE BY STEEL PENSTOCKS. DURING THE FILLING AND SUBSEQUENT DRAWDOWN OF THE RESERVOIR, SIGNIFICANT DAMAGE WAS SUSTAINED BY TUNNELS 1 AND 2 INCLUDING THE COLLAPSE OF A 300-FOOT SECTION OF TUNNEL 2. LESSER DAMAGE (TO THE OUTLET STEELS LININGS) OF TUNNELS 3 AND 4 WAS ALSO SUSTAINED. DAMAGE TO TUNNELS 3 AND 4 IS NOT CONSIDERED TO BE SERIOUS. REPAIRS HAVE STARTED ALREADY AND ARE EXPECTED TO BE COMPLETED IN A RELATIVELY SHORT TIME, SINCE THE INTAKE LEVEL OF THESE TUNNELS IS ABOVE THE PRESENT (TEMPORARY) INTAKES OF TUNNELS 1 AND 2 AND THE WORK AREA HAS BEEN COMPLETELY DEWATERED. THE DOWNSTREAM GATES OF TUNNELS 3 AND 4 HAVE ALREADY OPERATED UNDER VARIOUS HEADS AND GATE OPENINGS FOR A SUFFICIENT LENGTH OF TIME TO PROVE THEIR SATISFACTORY OPERATION AND THE CENTER GATES OF THESE TUNNELS ARE ALSO OPERATING

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SATISFACTORILY. THEREFORE, IT IS EXPECTED THAT TUNNELS 3 AND 4 WILL BE FULLY OPERATIONAL FOR THE PURPOSES OF RIVER DIVERSION AND IRRIGATION WITHIN THE CURRENT DRY SEASON.

10. IN ORDER THAT THE EVENTS LEADING TO THE FAILURE OF TUNNEL 2 AND DAMAGE TO TUNNEL 1 CAN BE FULLY UNDERSTOOD, IT IS NECESSARY TO GIVE A SHORT DESCRIPTION OF THE FUNCTIONS OF THESE TUNNELS DURING THE CONSTRUCTION OF THE DAM AND THE EVENTS WHICH TOOK PLACE DURING THE FIRST FILLING OF THE RESERVOIR. IN CONSTRUCTING THE DAM, THE INDUS RIVER WAS FIRST DIVERTED THROUGH A TEMPORARY CONCRETE DAM WITH SLIDING GATES. WHEN THE CONSTRUCTION

OF THE TUNNELS WAS COMPLETED IN SEPTEMBER 1973, TUNNELS 1 AND 2 AND THE EARTH DAM WAS EXTENDED TO THE RIGHT ABUTMENT BY CLOSING THE GAP THROUGH WHICH THE RIVER AHD PASSED DURING THE FIRST PART OF THE CONSTRUCTION.

11. RESERVOIR FILLING STARTED ON 1 JULY 1974 IN ACCORDANCE WITH A PREARRANGED PROCEDURE WHICH WAS BASED UPON ANALYSIS OF THE 106 YEARS OF RECORDED RIVER FLOW. THE PURPOSE OF THE PROCEDURE WAS TO REGULATE WATER RELEASES SO THAT DOWNSTREAM IRRIGATION DEMANDS WOULD BE MET AND YET SUFFICIENT WATER STORED SO THAT THE RESERVOIR WOULD REACH THE SPILLWAY CREST BY THE END OF THE 1974 WET SEASON. SOMETIME AFTER RESERVOIR FILLING HAD STARTED, HOWEVER, EROSION OF THE DOWNSTREAM COFFERDAM WAS OBSERVED, AND A FIELD DECISION WAS MADE TO ADJUST THE DIVERSION GATE CONFIGURATION OF TUNNELS 1 AND 2 TO MINIMIZE THE DOWNSTREAM TURBULENCE. IN SO DOING, HOWEVER, THE TEMPORARY DIVERSION GATES OF THESE TUNNELS JAMMED AND FOR THE FOLLOWING PERIOD THE FLOW PASSED THROUGH THESE TWO TUNNELS AT HIGH VELOCITY IN A PARTIALLY OPENED CONFIGURATION FOR WHICH THEY WERE NOT DESIGNED. IN MID-AUGUST WITH ALL FOUR TUNNELS DISCHARGING IRRIGATION WATER, ONE OF THE STEEL LINER PLATES IN TUNNEL 3 FAILED AND THE OUTLET GATES FOR TUNNELS 3 AND 4 WERE CLOSED TO PREVENT FURTHER DAMAGE TO THESE TUNNELS. IRRIGATION WATER WAS THEN ONLY BEING PASSED THROUGH TUNNELS 1 AND 2 WITH PARTLY OPEN INLET GATES AND AS THE RESERVOIR ELEVATION WAS ALREADY QUITE HIGH, EXTREMELY HIGH WATER VELOCITY IN THE TUNNELS RESULTED WITH THE FLOW PATTERN DISTORTED BY THE GATE CONFIGURATION. THESE VELOCITIES WERE MUCH HIGHER THAN UNDER NORMAL OPERATIONAL CONDITIONS FOR POWER TUNNELS. ON 21 AUGUST, TUNNEL 2 SHOWED SIGNS OF SEVERE DAMAGE AND IT WAS DECIDED TO DRAW DOWN THE RESERVOIR TO ASSESS WHAT DAMAGE HAD OCCURED. AT THAT TIME TUNNELS 3 AND 4

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WERE OPENED AGAIN BECAUSE OF THIS EMERGENCY, PASSING WATER THROUGH ALL FOUR TUNNELS; THE DRAWDOWN WAS COMPLETED ON 16 SEPTEMBER.

12. THE PRECISE CAUSE OF THE DAMAGE IS NOT YET KNOWN AND IN FACT MAY NEVER BE FULLY EXPLAINED. OPENING OF TUNNELS 1 AND 2 UNDER HIGH HEAD CONDITIONS WAS NOT PROVIDED FOR AND, THEREFORE, THE POSSIBLE HYDRAULIC PHENOMENA HAD NOT BEEN STUDIED IN A MODEL TEST. A NUMBER OF THEORIES ARE HELD AS TO THE CAUSE OF THE COLLAPSE OF TUNNEL 2 AND THE DAMAGE TO TUNNEL 1. THE MOST LIKELY EXPLANATION WAS THAT THE TUNNEL WAS SUBJECT TO EROSION AND CAVITATION UNDER HIGH VELOCITY FLOWS FOR WHICH THEY WERE NOT DISIGNED, AND THAT THE CONFIGURATION UNDER WHICH THE DIVERSION GATES WERE OPERATED AFTER THEIR FAILURE, CONTRIBUTED TO THE DAMAGE.

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ACTION TRSE-00

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UNCLAS SECTION 3 OF 3 MANILA 13847

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SUBJECT: TARBELA HYDROPOWER PROJECT, PAKISTAN

REF: TREASURY 74-12, MANILA 13600; ISLAMABAD 1104

(EXCLUDING ANNEXES)

13. RECENT VISUAL INSPECTION OF TUNNEL 2 BY BOAT HAS SHOWN THAT THE DAMAGE IS LESS THAN ORIGINALLY FEARED AND IT IS EXPECTED THAT REPAIR OF TUNNEL 2 WILL BE COMPLETED BY JANUARY 1975. DURING THE REPAIR WORK, THE PERMANENT CENTER GATES FOR TUNNELS 1 AND 2 WILL ALSO BE INSTALLED WHICH WILL ENSURE THAT BACK-UP GATES ARE AVAILABLE IN CASE ANY FURTHER PROBLEM WITH THE TEMPORARY INLET GATES IS EXPERIENCED WHEN THE RESERVOIR IS REFILLED IN 1975.

14. BANK STAFF ARE SATISFIED (AS ALSO THE STAFF CONCERNED IN THE WORD BANK AND THE VARIOUS CONSULTANTS RESPONSIBLE FOR THE DESIGN OF THE TARBELA DAM) THAT THE DAM STRUCTURE STOOD UP WELL UNDER
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THE SEVERE TESTING OF RAPID DRAWDOWN OF THE RESERVOIR. SEEPAGE UNDER THE DAM FOUNDATION AND THROUGH THE ABUTMENTS WILL BE FURTHER TESTED AND NO SIGNIFICANT PROBLEMS ARE EXPECTED. ONLY THE DAMAGE TO TUNNELS 1 AND 2 IS CONSIDERED SEVERE, AND REPAIR WORK IS PROGRESSING SATISFACTORILY; IT IS EXPECTED THAT WORK WILL BE SUFFICIENTLY ADVANCED TO ALLOW REFILLING OF THE RESERVOIR DURING THE 1975 WET SEASON. THE "SPECIAL CONSULTANTS" EMPHASIZED THAT THE TEMPORARY GATES IN TUNNELS 1 AND 2 SHOULD BE RETAINED FOR AT LEAST ONE YEAR, IN ORDER TO ALLOW COMPLETE DRAWDOWN OF THE RESERVOIR (IF NECESSARY) FOR INSPECTION OF THE SEEPAGE CONTROL MEASURES. HOWEVER, OPENING OF THESE GATES WOULD ONLY BE CARRIED OUT AT LOW RESERVOIR HEAD, SUCH THAT HIGH VELOCITY WATER FLOWS IN THE TUNNELS WOULD NOT BE REPEATED. BANK STAFF ARE SATISFIED THAT THE TUNNELS 1 AND 2 WILL NOT BE OPERATED AGAIN UNDER THESE ADVERSE CONDITIONS, AND THEREFORE THE PROBLEMS ENCOUNTERED DURING THE RESERVOIR FILLING IN 1973/74 WILL NOT RECUR.

15. A CATEGORICAL STATEMENT IN THE REPORT OF THE "SPECIAL CONSULTANTS" INSTRUCTS THAT IT IS ESSENTIAL TO RESTRICT FURTHER USE OF THE TUNNELS 1 AND 2 DIVERSION GATES TO PERIODS WHEN THE RESERVOIR IS BELOW ELEVATION 1200. THE BANK WILL OBTAIN THE DETAILED RESERVOIR FILLING PROCEDURES FROM THE RESPONSIBLE CONSULTANTS AS SOON AS THEY ARE AVAILABLE. FURTHERMORE, A WRITTEN ASSURANCE WHICH WILL BE DEEMED TO BE PART OF THE LOAN DOCUMENTS THAT THESE PROCEDURES WILL BE STRICTLY FOLLOWED WILL BE OBTAINED FROM THE GOVERNMENT AND WAPDA PRIOR TO BOARD DISCUSSION OF THE PROJECT. THIS ASSURANCE PROVIDES ALSO FOR THE BANK TO BE INFORMED ON ALL FINDINGS AS TO THE CAUSE AND EXTENT OF THE DAMAGE AND THE COST AND TIME REQUIRED AND THE PROGRAMME FOR SPECIFIC MEASURES TO REPAIR SUCH DAMAGE.

16. IN ORDER TO OBTAIN THIS ASSURANCE, AND TO CARRY OUT A VISUAL INSPECTION OF THE DAMAGE IN TUNNEL 2 AND OBTAIN THE LATEST PROGRESS REPORTS AND TIME SCHEDULES FOR THE NECESSARY REPAIR WORK, BANK STAFF IS VISITING TARBELA BETWEEN 9-14 NOVEMBER 1974. END QUOTE

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